Journals Ranking based on Usage Criteria for Collection Development in R & D Libraries: A Case Study of Bhabha Atomic Research Centre Library, Mumbai

Final Synopsis submitted to the Mangalore University in fulfilment of the requirement for the award of the degree of

Doctor of Philosophy

in

LIBRARY AND INFORMATION SCIENCE

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January, 2022

1. INTRODUCTION

Libraries and their collections have existed for thousands of years. The existence of a library in Red Temple at Uruk, Iraq dating from about 3000 B.C. proves the aforesaid statement. Collecting and organizing information and making it available to individuals have had a long history. A library collection is the sum total of library materials i.e. books, manuscripts, serials, government publications, pamphlets, catalogues, reports, recordings, microfilm reels, micro films, microfiche etc. (Samantaray & Rath, 2014). Libraries have not been immune to the growing difficulty of management problems in a world of increasing demand and decreasing resources.

The first scholarly journal emerged in the 17th century in order to make science more efficient. Journal publishing was intended to serve the purpose of avoiding duplication and advance scientific knowledge by building on results of colleagues (Mierzejewska, 2008). In addition, publication in a journal allowed researchers to claim their discoveries (Keller, 2005). The emergence of scholarly journals in the 17th century fundamentally changed the entire process of scholarly communication, which up to that point had been carried out through society meetings, books and letters (Price, 1963; Zuckerman & Merton, 1971). Librarians always face financial stringency due to exorbitant journal prices, and low library budgets. Certainly, many libraries are and will be considering how to prune, rather than expand, their journal collections.

1.1 Collection Development in Libraries

The term "collection development" refers to the process of systematically building library collections to serve study, teaching, research, recreational, and other needs of library users. Collection development is the systematic planning and rational building of library material. The term includes all activities involved in assessing the users' needs, evaluating the present collection, determining the selection policy, coordinating the selection of items, re-evaluating and storing parts of the collection and planning for resource sharing. It is not a single activity, but an agglomeration of activities (Parameswaran, 1997).

The elements of collection development policy, which needs to be reflected on the document are as follows:

- Institutional objectives
- Details of subject area
- Miscellaneous issues like gratis, weed-out, evaluation, complaints and censorship.

1.2 Journals in Library Collection

The term serials is used in a broader term, which includes the periodically published documents known as periodicals, journals, magazines, bulletins, newsletters, house journals, proceedings of the learned body and research institutions, newspapers etc (Mahapatra, 1999). The librarians face different kinds of problems during the different steps of acquisition like selecting, ordering and receiving. The section receives a lot of demand for acquisition of different titles in different core areas pertaining to different subjects. As a result, the section faces financial crunches. On the other hand, journals are the most important source of information as it contains the latest information in the form of research findings, survey reports and field studies reports etc. But the subscription prices of the journals are ever increasing due to the price hike in the cost of paper, printing etc. The changing characteristics of the journals are change in title, merging of titles/issues etc.

1.3 Relevant journal collection

Journals which are marginal to the library's main speciality are valued by users as they provide useful background to research projects. It is impossible at present to place a meaningful value on this information for background research, but some provision of this type of information gathering is essential. Another problem is seen in the provision of one or more journals specifically intended for one section of the users or for one person. If an organization requires the services of a specialist in a field marginal to its main activities, it is reasonable to argue that at least one journal should be supplied by the library to satisfy the individual's requirements. The diverse nature of communities served by special libraries has serious implications on the collection and evaluation of usage data.

1.4 Evaluation of journals

Scientific information is mediated through journals and the impact of them on society is uneven. Therefore, efforts have been and are being made for a long time to stratify journals and the quest for exploring the relative standing of the journals is continuing (Pichappan, 1993).

Mosher (1979) has observed that quantitative methods of evaluating library collections have become increasingly popular in recent years. Journal subscriptions typically take up a majority of collection budgets for libraries, yet journals often get less attention than monographs and other library resources in terms of collection development. To assure an effective current collection that best serves the mission of the organisation, librarians systematically remove materials from the collection using the following criteria:

- Usage
- Obsolescence
- User recommendation
- Duplication
- Discontinued research areas
- Accreditation requirements
- Availability of newer editions or material
- Collection analysis and evaluation

Local usage statistics are used in order to optimize journal subscriptions by basing them on actual cost-benefit equations (Cowhig, 2001; Keller, 2005). Reports of journal titles ranked by use with space and cost information included for each title can provide a means for making certain objective journal collection development decisions. This makes it an appropriate time to review the techniques suggested by and for librarians in journal ranking and selection. In search for a better method of journal selection, it is understood that the local usage is the apt criteria than a world usage of journals.

The present research aims to develop a methodology for evaluating the journals for the new subscription or stopping the subscription or continue the subscription in a library. The criteria for evaluating the journals must be based on the local usage rather than world usage. The journals used for publishing by the library clienteles, the

journals cited in the reference list of their published works and the journals citing their published articles can be the basis for assessing the usage. The ranking can be done based on the number of times used by the library users.

The aim of the present work is to develop a procedure that would satisfy all the requirements on a local library. The present study describes a methodological approach for the selection of scientific journals for any research organization or even a University level library.

2. LITERATURE REVIEW

The knowledge repositories on local usage of journals like bibliographical databases, repositories or literatures themselves are widely searched for literature. Scopus, Web of Science, Google Scholar, e-Shodhsindhu are some of the sources consulted for the literature. More than 108 articles/papers relevant to the topic are traced relevant to the topic of research. This includes journal articles, conference papers, books and chapters of books, technical reports, and websites.

In constructing the library collection, for example, librarians develop criteria for the selection and rejection of any of the materials for a particular collection (Rutledge & Swindler, 1987; Hunt, 1990). Although a criteria list may include as many as ten items, the library user is generally only referred to in an oblique manner: as the "demand" (Rutledge & Swindler, 1987) or as the "communal" (Atkinson, 1984). Where there is mention of meeting user needs, there is little description of exactly how these interests and needs are determined. Certainly, traditional criteria cannot be abandoned and collections built solely on user wants, but more objective data are required to help in the selection of the materials.

It is important to enquire about practical process for selecting journal titles, based on the objectivity and rationality of the model; and on the collection of the appropriate data and library statistics in a reasonable manner. A review of the literature reveals a number of attempts to establish a relationship between the user and the library collection.

The literature discussed general evaluation procedures of journals not for the purpose of selection and rejection or collection development are omitted from the study. Library-usage and user studies give an indication of their potential importance to librarians. A comprehensive and systematic literature search and review of more than 96 literture is undertaken in the present work in order to describe and evaluate the various methods of journal evaluation for selection or rejection in libraries. Most relevant 83 literatures are reviewed and presented here. The approaches adopted for the evaluation of journals for selection and rejection in libraries in the previous literature can be categorized as follow:

- ***Materials centered-approaches***: The techniques adopted generally may be citation analysis, cost-effectiveness, impact factor, classified profile
- ***Use and User centered approaches***: The methods of the approach may be counts of re-shelving, inter-library loan, circulation, point-of-use surveys in the library, Taking copies
- ***Combination of more than one method***
- ***Other new methods***

The scholarly literature (articles) which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to the present topic are also categoried and review findings are discussed in the following sessions:

2.1 Materials Centred Approaches

Bradford's law describes the number of core journals in a given field or subject and has recently been applied to neurosurgery. The objective of the study by Venable et al. (2014) was to use currently accepted formulations of Bradford's law to identify core journals in a narrow field. An additional analysis was completed to compare regional dependence on citation density among North American and European neurosurgeons. Hunt et al. (2011) demonstrated how to identify a core set of journals that frequently publish articles within a particular field and then, moreover, suggested a new method of ranking journals, derived from several measures rather than the Journal Impact Factor in isolation. Smith (2010) has utilized Scopus and Web of Science databases for his investigation to identify core journals in a subject by

proposing a ‘core’ journal list identified by way of bibliometric measures, such as citation counts and impact factors. Two bibliometric indicators were investigated in the current study; the first being total citations received for each journal and the second being journal performance indicators.

An essay by Rousseau’s (2002) provides an overview of journal evaluation indicators. It highlights the strengths and weaknesses of different indicators, together with their range of applicability. The definition of a “quality journal” different notions of impact factors, the meaning of ranking journals, and possible biases in citation databases are also discussed. Miller & O'Neill (1990) proposed a model for use in deselecting journals. The model includes an effectiveness factor determined by actual authors and users of journals. Based on suggestions from several scientific fields, the paper also examines several deselection models suggested and applied in academic libraries in the US using the impact factor of ISI.

2.2 Use and User Centred Approaches

A method for selecting and rating scientific and professional journals representing the discipline of ergonomics and human factors is proposed by Dul & Karwowski (2004). The ‘ergonomics journals’ focus exclusively on ergonomics and human factors. The ‘basic journals’ focus on other technical, medical or social sciences than ergonomics, but are important for the development of ergonomics/human factors. The article by Hatua (2001) emphasizes on limited budget and tries to find solution of the problem in journal selection by using the Theory of Marginal Utility. Also discussed here is how Bradford's Law is effective for cost analysis and journal selection.

2.3 Combination of Methods

Ugaz (2011) analyzed the journal evaluation criteria used to create the third edition of a core list of veterinary serials to determine the impact of each criterion on the final composition of the list in order to assess the value of using multiple criteria in creating a core list. A general model for the selection of scientific journals based on ranking of the data sources is presented by Oluić-Vuković & Pravdić (1990). The validity of the concept applied is supported by multiple testings of the model for journals in the field of chemistry.

2.4 New Methodologies

Madhugiri et al. (2013) made an endeavour to identify “core” journals in the field of neurosurgery and validate whether the h-index and impact factor truly identify the core journals in the subject. The researchers have assumed that identification of core journals in any medical fields make the individual physicians keep abreast of research and clinical progress. Hunt, et al. (2011) suggested a new method of ranking journals, derived from several measures rather than the JIF in isolation. The child and adolescent psychiatry field is used to illustrate the proposals. Moreover, for the purposes of comparison, how journals are selected for a given set of ‘like’ journals is somewhat arbitrary, as exemplified by the fact that some journals appear within several sets, and others that should be included are, mysteriously, not.

How to identify a core set of journals that frequently publish articles within a particular field is demonstrated by Jiménez-Contreras et al. (2006) proposed a bibliometric model for discarding journal volumes at academic libraries, i.e., removal to offsite storage as part of the library’s serials collection.

The study by Leydesdorff (2009), the new indicators like Impact Factor, Cited Half-life, and Immediacy Index of the ISI are compared with one another and with the older ones. The h-index combines the two dimensions and can also be considered as an indicator of reach (like Indegree). PageRank is mainly an indicator of size, but has important interactions with centrality measures. Hahn & Faulkner (2002) assessed the value of e-journals and the article explored the usefulness of available e-journal usage statistics and develops three metrics and three benchmarks based on those metrics. The proposed metrics was built on earlier work that assessed the value of print journals, although the earlier work is modified extensively to fit the e-journal arena. The e-journal statistics and metrics are further transformed to address a completely new area of application: the evaluation of potential purchases.

3. NEED AND SIGNIFICANCE OF THE STUDY

Organisations spend money for subscription of journals which are relevant to the library users and there is a need to assess the cost effectiveness and proper usage of the subscribed journals. Proper selection or weeding out of the journals within the allocated budget is needed for satisfying the demands of the users of any library. Journals collection development requires proper judgement about the usage of the journals by the library users. The journals which are of high impact may not be much useful to the local library users and the journals are of high importance/relevance to the library users may not be of very high quality when world usage is concerned. In the journals collection development processes, the local usage must be given due importance than the global usage of the journals. The ranking based on the local usage is very much needed in assessing the journals as part of collection development process. The ranking may be on: a) number of times the journals are used by the library community for publishing their articles, b) number of times the journals are referred by the scientific community when they write their research articles, c) number of times a particular citing the publications of a particular institute.

Bhabha Atomic Research Centre, Mumbai is a premier multi-disciplinary Nuclear Research Centre of India having excellent infrastructure for advanced Research & Development with expertise covering the entire spectrum of Nuclear Science & Engineering and related areas. Scientific Information Resource Division (SIRD) of BARC satisfies the scientific and technical information needs of more than 3000 researchers of BARC. As on Dec 2019, SIRD subscribes to 588 online journals, 109 journals in print format and 5 journals in online and print format as R& D support services.

The scientists and engineers are dealing with four set of journals:

- The journals subscribed by the parent organization
- Journals preferred by the scientists and engineers for publishing
- Journals referred in the publications of the researcher community
- Journals citing their publications

The access to all set of journals mentioned earlier except the first is treated as the basic requirement of imparting research in any organisations and it is a supporting system for any other information requirement of scientists and engineers in general. The following issues have identified when the local usage of journals of an institution is concerned:

- There are some set of journals being preferred by the users for publishing their research output/referred by the them in their published documents/citing the users' works but may not be subscribed by the parent institution.
- There are some set of journals subscribed by the parent organization but they may be seldom used for publishing their documents/referring in their publications/citing the users' works

Proper judgment in selecting journals for BARC Central Library must be based on the usage of journals by the researchers. The journals in which the researchers in BARC publish, and the journals they cite in their research works are assumed to be the most related, relevant and interested journals for them. The list of these journals will be useful for comparing with the journals subscribed by BARC Library so that a better selection criterion can be adopted.

The present study is needed for understanding the usage of the journals by the scientists and engineers served by BARC Library. The data can be used for changing the current policies adopted by the Library for selecting new journals, retaining the existing journals and stop subscription of certain journals.

4. STATEMENT OF THE RESEARCH PROBLEM

There may be libraries where the evaluation process of the resources and services does not happen at all. But there are libraries where evaluation of the resources and services is being carried out on a periodic basis, generally on annual basis. Along with other resources and services of libraries, journals are being evaluated by libraries.

Bhabha Atomic Research Centre Library

The Department of Atomic Energy (DAE) has been engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research. DAE comprises five research centers, three industrial organizations, five public sector undertakings and three service organizations. Bhabha Atomic Research Centre (BARC) Central Library comes under the Scientific Information Resource Division (SIRD) of BARC, Mumbai, India. The Division provides allied services like reprography, printing & binding, photography & Videography, foreign language translation and interpretation, document delivery and auditorium services. It was formally established by Atomic Energy Commission, Government as a small information unit in the year 1953 with the aim of providing facilities for translation of scientific and technical documents.

As on December 2019, Scientific Information Resource Division (SIRD) of BARC subscribes to 702 journals which includes 110 print journals which becomes an important support service for carrying out research. In addition to that BARC is part of Elsevier Science Direct Consortia and as a part of the consortia BARC has access to 1660 Elsevier journals. BARC Library has a long history of an apex committee and sub-committees (which is being updated every year) to evaluate the renewal and addition of new journals to the Library. For that last few years many criteria are used for evaluating journals in order to decide whether they should be renewed of discontinue subscription. Usage and cost effectiveness was the main concern when a particular journal is being considered for evaluation. Even though some of the criteria are apt to analyses, some of them show the world usage of the journals. At a later stage, Library started considering the local usage too.

At present there is no standard practice to solve the problems on an annual basis. Every year some of the earlier criteria were following to rank the journals. At the same time the researchers have felt the need for set policies to go about the collection development process. In an R&D set up where research is being done on multiple subjects, there may be varied opinions about the criteria to be used to evaluate journals from the user community.

The proposed study focuses on the "**JOURNALS RANKING BASED ON USAGE CRITERIA FOR COLLECTION DEVELOPMENT IN R & D LIBRARIES: A CASE STUDY OF BHABHA ATOMIC RESEARCH CENTRE LIBRARY, MUMBAI**".

5. OBJECTIVES OF THE STUDY

The present study has the main objective of ranking the journals based on institutional usage but has the following specific objectives:

i. To conduct a survey among those BARC scientists and engineers about the relevance of journals with the aim to assess how much relevant the journals for them in quantitative terms
ii. Rank the journals referred by BARC scientists and engineers in their publications based on number of times referred, number of times citing, and number of times preferred by BARC scientists and engineers for publishing their articles as per *Scopus* and *Web of Science* databases during 2010-2019. Re-rank the common journals by adding the ranks in both the lists.
iii. Identify the journals common to the referred by BARC scientists and engineers, preferred to publish their articles and citing their publications as per *Scopus* and *Web of Science* databases during 2010-2019 and re-rank them by adding the corresponding ranks of all the ranked lists.
iv. Present the year-wise trend and subject-wise trend of highly referred journals
v. Rank the journals based on the weighted average of usage and compare with the journals subscribed by BARC Library
vi. Calculate the rank correlation of the highly used journals based on *Scopus* and *Web of Science*
vii. Make observations, suggestions and conclusions based on the findings of the study.
viii. Prepare another set of journals based on the recommendations of BARC scientists and engineers.

6. HYPOTHESES

Hypotheses are tentative explanations that accounts for a set of facts and can be tested by further investigation. Kerlinger (1956) defined hypothesis as a "conjectural statement of the relation between two or more variables". Hypotheses are statements expressing the relation between two or more measurable variables and they should carry clear implications for testing the stated relations. In the present study, the variables are the number of journals used for referring in their published articles, publishing their articles and citing their published articles by BARC scientists and engineers. The following are the tentative hypotheses which can be drawn from the assumptions of the work plan:

- The journals referred in the publications of BARC Library users, journals used for publishing their articles and journals citing their published works are relevant to their research activities
- More than half of the journals are not being subscribed by BARC Library among the highly used journals.
- The rank correlation of the highly used journals and journals with high weighted average of occurrence is more than 0.6.
- The ranks of the highly used journals are immaterial when Scopus or Web of Science databases are used.

7. RESEARCH METHODOLOGY

There is difference between research methodology and research methods. Research methods are the ways through which the data is collected for the research is undertaken. The selection of the method adopting is depending upon the topic of research, the type of data going to be collected and the items or respondents from which the data is collected.

7.1 Research Methods

The research methods are of two types: 1) Quantitative Research Methods and 2) Qualitative Research Methods.

7.1.1 Quantitative Research Methods

Quantitative research is defined as a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical, or computational techniques. Quantitative research collects information from existing and potential customers. The research methods are called quantitative when closed-ended questionnaires/surveys or structured interviews are employed for data collection. Closed ended questionnaires contains premade answers and the participant of the survey have to choose from the list. It is very simple and the data recorded are easy to collate and quantify. Accuracy and understandability/clarity of the framed questions are very important. Simplicity, bias, sensitivity, comprehensiveness, confidentiality of the queries and length of the questionnaire determine the quality of the questionnaires.

Market researches are using structured interviews where the answers to pre-set questions are recorded quantitatively. These interviews may be conducted in person or over phone or even online.

Quantitative Research Measures are applied when questionnaires or interviews are conducted. The four levels of measures are:

- **Nominal:** These are numbers where the order of the numbers are immaterial and indented for identifying separate information.
- **Ordinal:** In this case order matters. For example rankings.
- **Interval:** Data are ordered and the interval between the numbers matters.
- **Ratio:** The data will always have a zero point. Data are measured generally measured from zero.

7.1.2 Qualitative Research Methods

Qualitative research is defined as a market research method that focuses on obtaining data through open-ended and conversational communication. This method is not only about “what” people think but also “why” they think so. Qualitative Research Methods consist of Focus Groups, Observation, Open-Ended Questionnaires, Semi-structured Interviews, Theoretical Analysis, and Unstructured Interviews.

7.2 Data Collection Tools

Data collection tools refer to the devices/instruments used to collect data, such as a paper questionnaire or computer-assisted interviewing system. Case Studies, Checklists, Interviews, Observation sometimes, and Surveys or Questionnaires are all tools used to collect data.

Questionnaires are regarded as the best form interviewing through paper. The two commonly used types of questionnaire items are the unrestricted, or open form items, and the restricted, or close form items (Singh, 2006). Open-ended questions are questions that allow someone to give a free-form answer. Closed-ended questions can be answered with "Yes" or "No," or they have a limited set of possible answers (such as: A, B, C, or All of the Above).

The scales being used in questionnaires have great importance as they decide the answering pattern of survey respondents. There are different types of response scales used in surveys. The main types are 1) Dichotomous, 2) Rating scales, and 3) Semantic differential scales. Dichotomous will generally two choices like 'Yes or No', 'True or False' etc. In rating scales, the attitudes/feelings of the respondents are presented in the form of scales. The four most common rating scales are:

- 11-point scale;
- 4 Point Likert Scale;
- 5 Point Likert Scale
- 7 Point Likert Scale

7.3 Questionnaire

A well-designed survey questionnaire may involve many factors like unintended ways by the wording of the queries, the order of the queries, the response options provided etc. The factors influencing the respondents decides the amount of noise in the collected data. At worst, they result in systematic biases and misleading results. The present questionnaire has tried to minimize the unintended effects and thereby maximize the reliability and validity of respondents' answers. The questionnaire was sent through the author email ids, one-week time was provided for the feedback, and the responses are expected through email only. The participants were also assured that their anonymity would be maintained and the collected data will be used only for

academic purpose. Some of the participants were reminded after one week of expectation time.

7.4 Research Methods Adopted

A well-structured questionnaire is designed with varying scales in order to measure relevance of journals in terms of percentages. The survey participants are asked to measure how much relevant the three set of journals in the present study are relevant to their research activities. The questionnaire prepared and to be distributed among the authors of the papers are as follows:

The questionnaire was sent through the author email ids and one-week time was provided for the feedback. Scopus database is used for eliciting the information about the journals in which BARC scientists and engineers publish their articles. Web of Science database is made use of for retrieving publication data of BARC scientists & engineers. MS Excel is a commonly used Microsoft Office application and spreadsheet program which is used to save and analyse numerical data. MS Excel is extensively used for getting the frequency of usage as well as comparison purpose.
The journals which are of high impact at the global level may not be much useful to the local library users and the journals are of high importance/relevance to the library users may not be of very high quality when world usage is concerned. The ranking based on the local usage is very much needed in assessing the journals. Local usage must be given due importance than the global usage of the journals when journal collection development decisions are taken.

Library users make use of journals which are of relevant to them. As discussed in the earlier sessions following are the three list of journals connected with library user community:

- Journals which are referred by the user community in their published articles
- Journals preferred for publishing their articles
- Journals which are citing the research articles published by user community

A survey is conducted to seek the relevance of journals through a questionnaire. The respondents are asked to mark relevance of the three set of journals in terms of percentages.

The study has determined ranked list of journals mentioned above based on the usage. Since the data is based on *Scopus* and *Web of Science* databases, six set of ranked lists of journals are identified. It is not necessary that all journals are occurred in all six set of journals. Since the journals occurring in different journal sets, the weightage in occurring in different set should vary as they have different relevance as per the opinion of scientists and engineers. The weights are applied to the number of times the journals occurred in six set of journals. The weights are added and finally the list of all journals occurred in six set of journals are ranked.

The Weighted Average (WA) is calculated as:

$$WA = \frac{94.78x300 + 94.19x92 + 94.70x8 + 94.78x334 + 94.19x84 + 94.70x8}{2(94.78 + 94.19 + 94.70)}$$

$$= 137.81$$

The rank correlation is a distribution free test that determines whether there is a monotonic relation between two variables (x, y). A monotonic relation exists when any increase in one variable is invariably associated with either an increase or a decrease in the other variable. The monotonic relation is expressed using rank-order numbers instead of the values. This also makes the Rank Correlation a test distribution free test. Now, the correlation coefficient can be computed for the given numerical values, which are in the form of ranks. This coefficient of rank correlation is denoted by r_{rank} or briefly r and is calculated by the equation:

$$r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2-1)^2}$$

Where d = differences between ranks of corresponding x and y
n = number of pairs of values (x,y) in the data

The above equation is called as the Spearman's Formula for Rank Correlation (Spearman, 1904). A value of r rank near one indicates good agreement, a value near zero, poor agreement.

Scopus and Web of science databases are almost in similar in nature with a slight journals coverage variation. Finally, the present work has evaluated if the study has been done only with a single database what would be the outcome. In order to evaluate that factor a Rank Correlation test has conducted on common journals appeared in the list of journals appeared in both Scopus and Web of Science databases.

7.5 Study Design

As research methodology 8.1, the list of journals in which articles published by BARC scientists and engineers during 2010-2019, journals referred in these articles, journals citing these published articles are the main focus of the present study. The top ranked number of journals selected for the study are roughly 700 which is nearly equal to the number of journals subscribed by BARC library in the year 2019. The six different list of journals as per the objective of the study are:

1. Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Scopus Database
2. Journals citing publications (2010-2019) of BARC scientists & engineers as per Scopus Database
3. Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Scopus Database
4. Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Web of Science Database
5. Journals citing publications (2010-2019) of BARC scientists & engineers as per Web of Science Database
6. Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Web of Science Database

The six list of journals above will be checked against the list of journals subscribed by BARC Library. The journals which are not subscribed by BARC will be ranked based

on the number of times occurred and the ranks are indicative of how important the journals are for the scientists and engineers and the need for availability in Library. The ranks will be added up for the commonly occurred journal titles. The ranks of journals which are occurred in all the six lists will be added up and again ranked the journals based on the total rank.

As per research methodology 8.2, the number of times the user community uses the journals for the above purposes can be one of the measures to assess the usage. The download statistics shows a trend of usage of online journals but it doesn't mean that all the downloaded articles are being read by the users. Among the usage by the user community, referring the journals in the publishing articles is the best way of assessing the usage, because the library user reads the articles from the journals they refer. And it is not necessary that those journals are there in the library collection.

The study is aimed at making three list of journals and rank them according to the number of times used. The three list consist of:

1. Journals referred in the published list of the scientists and engineers of BARC from both Scopus and Web of Science databases
2. Journals preferred by BARC scientists and engineers in their published articles and included in Scopus and Web of Science databases
3. Journals citing the publications of BARC scientists and engineers as reflected in both Scopus and Web of Science databases

The weighted average is calculated for all individual journals occurred all the six lists and compared. Then the question arises when a journal does not appear in any of the lists what would be the weightage?. In case any journal does not appear in a particular list then the weight of that journal for that list will be zero.

7.6 Study Population

Bhabha Atomic Research Centre, Mumbai is a premier multi-disciplinary Nuclear Research Centre of India under Department of Automatic Energy (DAE) having excellent infrastructure for advanced Research and Development with expertise covering the entire spectrum of Nuclear Science and Engineering and related areas. Scientific Information Resource Division (SIRD), which is coming under the

Knowledge Management Group of BARC act as the nodal point for all type of information needs of BARC scientists and engineers. SIRD is keenly involved in supporting the R&D efforts of 3500 researchers of BARC.

BARC is a premier research institute in India with a yearly average of 1400 journal publications. The year-wise number of journal publications are presented in Table 1. As per Scopus and Web of Science databases, the total number of publications from BARC from its inception are 39,110 and 35668 respectively as on end of January 2021.

Table 1.: Year-wise number of journal articles published as per Scopus and Web of Science Databases

Publishing Year	Number of journal articles as per Scopus	Number of journal articles as per Web of Science
2010	1087	1078
2011	1219	1192
2012	1316	1249
2013	1369	1298
2014	1578	1460
2015	1462	1310
2016	1574	1395
2017	1588	1389
2018	1437	1226
2019	1479	1248

7.7 Study Sample

Even through there are many formulas applied to get a sample size of population, Yamane (1967) provides a very simplified formula to calculate sample sizes. The formula is as follows:

$$n = \frac{N}{1+ N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision.

BARC has a scientific staff strength of nearly 3500 who are directly involved in R&D activities in various fields. The criteria for selection is that the participants should have at least one published document as per Scopus database during 2018-2019. This was confirmed through Scopus database. According to the formula, 359 is the minimum as a sample. The study has chosen 1703 researchers as a sample to get the response about the precise relevance of the three set of journals.

The documents published by BARC scientists & engineers during 2010 to 2019 are taken as sample of the study regarding the usage of journals. The documents from two databases namely Scopus and Web of Science are taken as separate samples. The populations and sample selected figures are presented in Table 2.

Table 2.: Population of journal articles and sample selected from Scopus and Web of Science Databases

Parameter	**Number of papers published in Scopus**	**Number of papers published in Web of Science**
Total Population	39110	35668
Sample	14019	12845

7.8 Pilot Study

A pilot study had undertaken to assess the local usage of journals based on the referred journals in the publications of a research institute as a pilot study. This study is being carried to have insights for a better journal collection development. The results of the pilot study are published as a journal article (Naik & Prakash, 2020). The researcher has made necessary changes to the pilot study and re-designed the present work as per the objectives and suggestions of the guide and other subject experts.

7.9 Data collection

Scopus database was employed to elicit bibliographic data on journal articles published by BARC and data on journals citing BARC publications are collected separately. The records are downloaded as batches of 2000 as Scopus database allows only 2000 records at a time. Web of Science database is also employed to elicit similar data and as it is done using Scopus, citing journals had to be downloaded separately. Web of Science also has a download limit of 500 records at a time.

7.10 Data analysis

Data analysis is the process of evaluating data using the logical and analytical reasoning to carefully examine each component of the data collected or provided. There are a variety of methods for these types of analysis, but all of them fall under two main methods that are Qualitative Analysis and Quantitative Analysis. The quantitative analysis is used for the quantification of data which allows the generalization of the results obtained from a sample to a population of interest. Simply put, statistical methods of data analysis are used to collect raw data and transform it into numerical data. Data collected through two databases are transferred to MS-Excel spreadsheets and further analysis are carried out. The data collected through questionnaire are input in again in MS-Excel spreadsheets and calculations on weighted average are done.

8. SCOPE AND LIMITATIONS OF THE STUDY

A number of formal statement that limits or restricts some claim need to be noted regarding the present study. The main limitations are expressed as follows:

- The current work is limited to the usage of journals by scientists and engineers of Bhabha Atomic Research Centre (BARC), Mumbai. The present work in limited to only BARC because the institute is a multi-disciplinary research institute and has more than 3500 researchers working in a single location. A study of this kind at the national level is not feasible in a country like India with its vastness, multiplicity of language, and large number of R & D institutions. Hence the study is limited to the BARC Library, Mumbai.
- The published records of BARC scientists and engineers are restricted to the journal articles included on Web of Science and Scopus databases.
- The publications of BARC scientists and engineers are limited to only last 10 years. The study is limited to the last ten years because it is quite natural that the usage trend of earlier times will be different from the usage pattern of the recent ten years as the research front is keep on changing in research institutes like BARC.
- The number of scientists & engineers chosen as sample is limited to those who have at least one publication on their name.

- There is no much uniformity in inputting the cited references in journal articles in both Web of Science and Scope records. Therefore, the cited journals will be restricted to top cited journals which are almost equal to the number of subscribed journals by BARC.

9. CHAPTERISATION

Keeping in view the aims and objectives of the present research study, the thesis is organized into the following seven chapters:

Chapter I: The first chapter will give an introduction to the research problem in hand by describing the journals collection development, journal evaluation for the collection development, evaluation criteria, ranking of journals for the purpose etc. The chapter includes an overview of the topic, highlights the need for the present study, problems, defines the basic concepts, states the objectives of the study and provides summary of the remaining chapters.

Chapter II: Literature review includes a brief review of literature on the subject selected for study. The literatures are categorized based upon the type of evaluation criteria used for assessing the usage of journals. Materials centered-approaches, Use and User centered approaches, Combination of more than one method, other new methods for evaluation of journals are the major categorization of the literatures. The discussions on the literatures analysed are arranged in chronological order of publishing.

Chapter III: Research methodology, objectives of the study, hypothesis, scope and limitations of the study will be described in detail in this Chapter. The chapter will justify the reasons for adopting the particular methodologies and the statistical parameters chosen for the analysis.

Chapter IV: The chapter will journal ranking in specific purposes and ranking criteria for collection development purpose. The profile of the institution under study (Bhabha Atomic Research Centre, Mumbai) will be included in this Chapter.

Chapter V: The results of the analysis and interpretation of the collected data on journal usage will be presented in this Chapter. Apt statistical parameters will be discussed and presented in the Chapter.

Chapter VI: The discussions and research findings of the study along with suggestions for future research will be presented in this Chapter. Constructive suggestions will be included to improve the collection development programmes in libraries. In this chapter, statements may be made on the importance of methods to evaluate journals for the purpose of collection development.

10. FINDINGS AND OBSERVATIONS

In order to assess the adequacy of the journal collection in terms of the research needs several evaluation procedures are to be used. Collection-centered evaluations included many ways to assess the importance of a particular journal in the library collection. Despite the widespread analysis of usage data of various types in making collection management decisions, the method described in research methodology may be a best and easiest way of assessment. The study has presented the results of the analysis and arrived at outcomes on different aspects of the study. The results of the present study as per the objectives of the study are discussed in the forthcoming sessions.

10.1 Survey responses

The number of scientists and engineers taken as sample for the survey was 1703 and the number of scientists and engineers responded is 768 and the response rate was found as 45.86 % (768 out of 1703). The queries are properly attended by the respondents and no respondents have left any queries unfilled. The respondents are from different subject areas and different age groups. The focus of study is not related to these factors but still Figure 2 presents the bifurcations of subject areas wherein the 768 participants are working in.

10.2 Relevance of journals

The authors look for the place to publish their scientific work, caring mostly for the databases in which the journal is indexed, its impact factor and own academic advancement; while the editors are burdened with everyday problems of their work – money, troubles with peer review, catching deadlines, and finances (Marusic and

Marusic, 2009). Authors publish journal articles making them open to comparisons, critique, and improvement; unnecessary research of already known facts is avoided, and it enables the weakest to learn from the most knowledgeable. All those who have had their articles published in respectable journals automatically have a precious, albeit often a painful, experience that their work, ideas, and presentation of data have passed through a merciless scrutiny of the best experts for the given medical field.

The study had assumed that the journals in which the library users prefer to publish, journals referred by library users in their publications and journals citing their published papers are relevant to their research activities. A survey was conducted among the scientists and engineers of BARC to have an understanding about how much relevant the above-mentioned set of journals for their R&D in quantitative terms. The following table (Table 3) provide the respondents' opinion about the relevancy of different set of journals.

Table 3: Responses about the relevancy of the journals used by scientists and engineers of BARC

Type of journals	**60-70%**	**71-80%**	**81-90%**	**91-100%**	**Weighted Average**
Journals referred	0	2	13	753	94.78%
Journals preferred for publishing	0	5	13	750	94.70%
Journals citing publications	3	9	35	721	94.19

From the above data, it is evident that the three set of journals (journals in which BARC scientists and engineers prefer to publish, journals referred in their publications and journals citing their publications are very much related to or relevant to research area where in BARC scientists & engineers are working in and they would like to have access to those set of journals.

10.3 Ranking of journals

Usage statistics play an important role in evaluating any online services especially online journals. Outcome of data can be used to improve performance measures and is used to justify services offered by the organisation. Ranking of journals by usage is

extensively used to evaluate them for subscription related decision making and fund allocation. Ranking of journals based on three criteria and using two databases viz. *Scopus* and *Web of Science* have been done and following sessions discuss about the outcomes of the ranking. The following Table 4 presents some of the nomenclature used and some information regarding the selection of journals to make the ranked lists. The number of journals in each rank list will be near to 702 which is the number of journals subscribed by BARC Library in 2019. It will be difficult to keep exactly 702 journals in each list because the ranks may be equal for journals near to the number 702.

Table 4: Various list of journals considered for ranking with number of journals and nomenclature used for ranks

Type of journal list	**No. of journals**	**Frequency Nomenclature**	**Rank Nomenclature**
Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Scopus Database	692	F_{rs}	R_{rs}
Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Web of Science Database	690	F_{rw}	R_{rw}
Journals citing publications (2010-2019) of BARC scientists & engineers as per Scopus Database	702	F_{cs}	R_{cs}
Journals citing publications (2010-2019) of BARC scientists & engineers as per Web of Science Database	712	F_{cw}	R_{cw}
Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Scopus Database	733	F_{ps}	R_{ps}
Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Web of Science Database	656	F_{pw}	R_{pw}

10.3.1 Ranking of referred journals (Scopus)

The number of documents referred in 15,911 BARC publications in Scopus database during 2010-2019 is 5,62,082. The referred documents in Scopus database records of publications do not have particular format or consistency. It is very difficult to make the referred journals in a consistent way and make a single list. Instead of checking 5,62,082 records for the journals referred, the study has identified near to 1400 (two times the number of journals subscribed by BARC Library (702)) journals which are highly referred. Then the journals are looked for various forms used, finally ranked them and got a list of 694 journals. The list has been compared with the list of journals subscribed by BARC Library and it has found that 423 journals (60.95 % of 694 journals) are not being subscribed by BARC Library. These journals are ranked based on the number of times referred and listed in Table 5 (Table listed only 25 journals and rest of the journals will be included in Thesis).

Table 35 Ranked list of referred journals (non-subscribed) as per Scopus database (2010-2019)

Journal	**F_{rw}**	**R_{rw}**
Journal of High Energy Physics	7877	1
Phys Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	5176	2
Journal of Physics C: Solid State Physics	4018	3
Physical Review	3931	4
European Physical Journal C	3924	5
Journal of Physics A: Mathematical and Theoretical	2888	6
Journal of Physics Chem	2730	7
Journal of Chem Soc: Dalton Trans	1984	8
Proceedings of The National Academy of Sciences of the United States of America	1858	9
Journal of Materials Chemistry	1755	10
Radiochimica Acta	1747	11
Journal of Nanoscience and Nanotechnology	1183	12
Journal of Physics G: Nuclear and Particle Physics	1131	13
Acc Chem Res	1119	14

Journal	**F_{rw}**	**R_{rw}**
Journal ff Applied Crystallography	1009	15
ACS Applied Materials and Interfaces	985	16
Scientific Reports	922	17
Nuclear Instrum Methods	849	18
Journal of Physics Chem Lett	826	19
Acta Metall Mater	807	20
Plos One	801	21
Journal of Agricultural and Food Chemistry	786	22
Nucleic Acids Research	669	23
Soft Matter	654	24
Medical Physics	650	25
Detailed table is given in Thesis		

10.3.2 Ranking of referred journals (Web of Science)

As per Web of Science database, BARC has published a total of 13,803 documents and these publications altogether have 4,97,821 references. Among these references 691 journal titles are identified as highly used and ranked based on number of times referred. Out of these 691 journals 417 (60.35%) are not being subscribed by BARC Library. The journals which are not subscribed by BARC Library will be listed in Table 6 and this list itself may be used as a tool to evaluate the usage of journals and may be used for selection related decisions.

Table 6: Ranked list of referred journals (non-subscribed) as per Web of Science database (2010-2019)

Journal	**F_{rw}**	**R_{rw}**
Journal of Physics C: Solid State Physics	4327	1
Science	3319	2
Journal Of Physics A: Mathematical and Theoretical	3024	3
Journal of Physics Chem	2530	4
Phys Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	1944	5
Physical Review	1922	6
Proceedings of The National Academy of Sciences of the United	1826	7

States of America		
Radiochimica Acta	1798	8
Journal of Materials Chemistry	1764	9
Journal of Nanoscience and Nanotechnology	1266	10
Accounts Chem Res	1108	11
Acs Applied Materials and Interfaces	1064	12
Journal of Applied Crystallography	1044	13
Detailed table is given in Thesis		

The journals identified in the above two tables are really highly used by the BARC scientists and engineers. Identification of highly referred journals was particularly useful because of the interdisciplinary nature of BARC and the heavy reliance on journals. The tables will be of utmost useful for taking collection management decisions. Low ranked journals which are already subscribing can be definitely the list of journals to be discontinued.

10.3.3 Common referred journals (Scopus and Web of Science)

There are 461 journals found common in two lists of journals highly referred by BARC scientists and engineers as per Scopus and Web of Science databases. The journals re-ranked after adding the respective ranks based on both the databases and will be listed in Table.

10.3.4 Ranking of journals citing (Scopus)

The journals citing BARC publications may be from varied subjects because the literature published may be cited for various discussions and at various levels of discussion. The study has identified 702 journals citing BARC publications very frequently which contains journals subscribed and not subscribed by BARC. The journals not subscribed by BARC constitutes 65.10% (457 journals) of total highly used 702 journals.

10.3.5 Ranking of journals citing (Web of Science)

The journals citing BARC publications as per Web of Science database are analysed and made a list of 712 journals based on the number of times citing. Out of these 712 journals 466 journals (65.44% of total) are not subscribed by BARC and they are ranked based on the number of times citing.

10.3.6 Common citing journals (Scopus and Web of Science)

The study has identified common journals from two list of journals most frequently citing BARC publications as per Scopus and Web of Science databases. The ranks of the 552 journals common to the two list are added up and re-ranked. The common journals which are highly used as per both the databases are regarded more specific than individual lists.

10.3.7 Ranking of journals preferred for publishing (Scopus)

Preferred journals for publishing articles by BARC scientists and engineers are analysed and made a list of most preferred 733 journals with number of times used for publishing articles as per Scopus database. There are 469 (63.98%) out of these 733 journals which are not being subscribed by BARC Library. The 469 journals are ranked based on the number of times used for publishing articles.

10.3.8 Ranking of journals preferred for publishing (Web of Science)

The journals preferred for publishing by BARC scientists and engineers as per Web of Science database are analysed and arrived at a list of most preferred 656 journals. The journals are again segregated as subscribed and not subscribed by BARC Library and the number of journals not subscribed by Library is 404 (61.59%). The few journals not subscribed by BARC Library ranked based on number of timed used for publishing articles are identified.

10.3.9 Common journals preferred for publishing (Scopus and Web of Science)

The two set of journals preferred by BARC scientists and engineers for publishing their articles as per Scopus and Web of Science journals. There are 635 journals common to two set of journals and out of these 384 (60.47%) journals are not being subscribed by BARC Library. The ranks of the non-subscribed journals in the

concerned lists are added up and re-ranked based on the sum of the ranks and identified the list.

10.3.10 Common journals in ranked lists of referred journals and journals preferred for publishing

The study has identified the journals not subscribed by BARC Library and ranked them based on the number of times they are referred in the publications of BARC scientists and engineers and the number of times used for publishing their articles. The records are taken form the *Scopus* and *Web of Science* databases for the publication period 2010-2019. The two ranks of the common journals are added up and re-ranked and identified the list of top ranked journals.

10.3.11 Common journals in ranked lists of referred journals and journals citing publications of BARC

The journals referred in the publications of any institute are relevant to the institutional research and the journals citing the articles published by the institute are relevant to the institute as well. The present study has separated out the journals not subscribed by BARC Library and occurred in the ranked list of journals referred in the publications of BARC and the journals citing BARC publications based on the data from *Scopus* and *Web of Science* databases. The period chosen was the publication years from 2010 to 2019. The ranks of the common journals in both lists are then added up, re-ranked them and presented.

10.3.12 Common journals in ranked lists of journals citing publications of BARC and journals preferred for publishing

The journals citing an institute's publications and journals preferred for publishing that institutes research outputs are relevant to the institution although the journals referred in the publications of any institute is more relevant than these two sets of journals. Here the journals citing BARC publications and journals preferred for publishing BARC's articles are identified and separated out the journals not subscribed by BARC Library. Journals citing BARC publications are ranked based upon the number of times citing and journals preferred for publishing BARC publications are also ranked based upon the number of times used for publishing using the data from *Scopus* and *Web of Science* databases for the publication period

2010-2019. The list of common journals are prepared after adding the ranks and re-ranked.

10.3.13 Common journals in all the six lists

The data on Journals referred in BARC publications, journals citing BARC publications, and journals preferred for publishing by BARC scientists from both *Scopus* and *Web of Science* databases are taken for the publication periods 2010 to 2019. The journals are ranked based on number of times they occurred as referred journals, citing journals and preferred journals respectively. The ranks of the top 29 common journals from all the six lists are all added up, re-ranked. All the three ranks of journals based on number of times referred in the publications of BARC scientists and engineers, citing BARC publications and preferred for publishing BARC's articles as per Scopus and Web of Science databases (2010-2019) are added and identified the most used journals not subscribed by BARC Library.

10.4 Rank by Weighted Average of Usage

As per the survey conducted, the relevance of journals referred is 94.78%, journals citing BARC publications is 94.19% and journals chosen for publishing by BARC is 94.70%. Accordingly, the journals referred in the publications should have more weightage than the journals citing and journals used for publishing. The study has observed that some journals not occurred in all the six set of ranked list of journals. Some journals occur in one or two ranked lists but not in other lists. The study proposes to provide weightage to the occurrence of journals in three different lists viz. Journals referred by BARC Scientists and Engineers, Journals citing BARC publications, and Journals chosen for publishing by BARC. The weightages are given as per the opinion of the scientists and engineers about the relevance of journal lists. For instance, as per their opinion, the journals referred in the publications are more relevant than the journals preferred for publishing their articles. In this case, the journals occurring in the list of referred journals should have more weightage than the journals preferred for publishing. The weightage has been calculated for the journals occurring in all the set of six lists as per the formula given in research methodology. The ranks are calculated and identified the highly used journals.

10.5 Rank Correlation based on *Scopus* and *Web of Science* Data

Spearman's rank-correlation coefficient (also called Spearman's rho) one of the extensively used and best-known measures for quantifying the degree of interdependence between two variables (Gaibler & Schmid, 2010). The measure assesses how well the relationship between two random variables where both variables are described using a monotonic function.

As per the objectives of the study, the common journals appeared in three set of journals related to Scopus (Referred, Citing and Published) and the other three set of journals related Web of Science (Referred, Citing and Published) have taken into consideration. The ranks of journals based on number of times occurred in three lists related to Scopus are added up and re-ranked. Similarly, the same journals are re-ranked using the lists related to Web of Science. Among the top ranked 100 journals when the exercise is done with *Scopus* and *Web of Science*, 61 journals are found common in both the two ranked lists. Then Spearman's rank-correlation coefficient r_{rank} is calculated for these 61 journals and found as 0.94. The value is very close to 1 which indicates that the journals are almost in the same order of ranking.

11. TESTING OF HYPOTHESIS

Hypothesis 1: ***The journals referred in the publications of BARC Library users, journals used for publishing their articles and journals citing their published works are relevant to their research activities.***

The study has assumed that the journals referred by BARC Library users, journals preferred by them to publish their journal articles and the journals citing their articles are relevant to their research programmes. A survey has been conducted among the Library users and the responses from 768 participants are undergone χ^2 test. The response regarding the journals refer in their publications are highly relevant as seen in Table 7 that 99.74% respondents stated that the journals referred in their publications are more than 80% relevant and only 0.26 % say that the journals are 60-80% relevant. The number of respondents who stated that the relevance of journals BARC Library

users prefer to publish is more than 80 % is 99.35% and the respondents stated the relevancy is between 60-80% is only 0.65%.

Table 7: Percentage of opinion by BARC scientists & engineers about how much relevant the journals which they refer in their publications, which they prefer to publish their articles and the journals citing their papers in quantitative terms

Journals Choice	**< 60 %**	**60 to 80 %**	**>81 %**	**Total**	**χ^2 Value**
Referred journals	0	0.26	99.74	768	**χ^2 (1)** = 760.021 **P=.000**
Journals prefer to publish articles	0	0.65	99.35	768	**χ^2 (1)** = 756.047 **P=.000**
Journals citing their articles	0.39	1.17	98.44	768	**χ^2 (1)** = 720.750 **P=.000**

The Chi Square test applied for hypothesis 1, the F value related to journals referred by the scientists and engineers is 760.021 and P value is .000, the F value related to journals prefer to publish their articles is 756.047 and P value is .000 and the F value for journals citing their articles is 720.750 and P value is .000. The p value is highly significant and this hypothesis is proved.

Hypothesis 2: *More than half of the journals are not being subscribed by BARC Library among the highly used journals.*

The study has identified six lists of nearly highly used 702 journals (number of journals subscribed by BARC Library) based upon three criteria (number of times referred, number of times citing BARC publications, and number of times used for publishing articles) as per the data in *Scopus* and *Web of science* databases. Each list contains journals which are not being subscribed by BARC Library. In order to test the hypothesis, percentage of journals subscribed out of the highly used journals are calculated. The detailed figures are provided in Table 8. In all the six cases, more than 50% percentage of journals are not being subscribed by BARC Library among the highly used journals and hence hypothesis proved. It is also observed from the table that the journals which are not subscribed by BARC Library is more in the list of journals citing the publications followed by list of journals preferred for publishing.

Table 8: List of ranked journals based on three criteria and number of journals not subscribed by BARC Library.

Type of journal list	**No. of journals considered on top**	**No. of journals not subscribed by BARC**	**Percentage of journals not subscribed by BARC**	**Rank**
Journals citing publications (2010-2019) of BARC scientists & engineers as per Web of Science Database	712	466	65.44	1
Journals citing publications (2010-2019) of BARC scientists & engineers as per Scopus Database	702	457	65.10	2
Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Scopus Database	733	469	63.98	3
Journals preferred for publishing BARC scientists & engineers during 2010-2019 as per Web of Science Database	656	404	61.59	4
Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Scopus Database	692	423	60.95	5
Journals referred by BARC scientists & engineers in their publications (2010-2019) as per Web of Science Database	691	417	60.35	6

Hypothesis 3: ***The rank correlation of the highly used journals and journals with high weighted average of occurrence is more than 0.6.***

The present work has assumed that the rank correlation of ranked list of journals in terms of high usage (not subscribed by BARC Library) and the weighted average usage of journals which may or may not occurred in the ranked lists will be more than 0.6.

Rank correlation is calculated as follows:

$$\text{Rank Correlation} = r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2-1)^2}$$

$\Sigma d^2 = 1,07,937$

$n = 61$

$$r_{rank} = 1 - \frac{6 \times 107937}{61\,(61^2 - 1)^2} = 0.99$$

The rank correlation has been calculated and it is found as 0.99 and hence hypothesis proved. Top 61 highly used journals common in the ranked list of journals based on usage and weighted average are identified.

Hypothesis 4: ***The ranks of the highly used journals are immaterial when*** **Scopus** ***or*** **Web of Science** ***databases are used.***

Another assumption of the study was the journal usage ranking will not alter with the use of either Scopus or Web of Science databases. Rank correlation (r) was used to test the data. Data for the rank correlation is provided in Table 9.

$$\text{Rank Correlation} = r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2-1)^2}$$

Table 9.: Ranks of journals as per Scopus and Web of Science and Rank correlation parameters.

Journal	**Scopus Ranks (s)**	**Web of Science Ranks (w)**	**Difference (d=s-w)**	**d^2**
JOURNAL OF HIGH ENERGY PHYSICS	1	7	-6	36
EUROPEAN PHYSICAL JOURNAL C	2	9	-7	49
SCIENTIFIC REPORTS	3	1	2	4
RADIOCHIMICA ACTA	3	4	-1	1
Plos One	4	2	2	4
ACS Applied Materials and Interfaces	5	3	2	4
European Physical Journal A	6	6	0	0
Journal of Physics G: Nuclear and Particle Physics	7	8	-1	1
Journal of Nanoscience and Nanotechnology	8	5	3	9
Journal of Molecular Liquids	9	10	-1	1
Soft Matter	10	12	-2	4
Journal of Analytical Atomic Spectrometry	11	11	0	0
Lancet	12	22	-10	100
European Journal of Inorganic Chemistry	13	15	-2	4
Journal of Organometallic Chemistry	13	19	-6	36
Journal of Agricultural and Food Chemistry	14	14	0	0
Analytical Methods	14	16	-2	4
Chemphyschem	15	13	2	4
Crystengcomm	15	13	2	4
Analyst	16	17	-1	1
Nuclear Data Sheets	17	18	-1	1
Journal of Nanoparticle Research	18	20	-2	4
Desalination and Water Treatment	19	21	-2	4
European Journal of Nuclear Medicine and Molecular Imaging	20	25	-5	25

Journal	Scopus Ranks (s)	Web of Science Ranks (w)	Difference (d=s-w)	d^2
Medical Physics	20	35	-15	225
Crystal Growth and Design	21	27	-6	36
Journal of Materials Chemistry	22	26	-4	16
International Journal of Biological Macromolecules	22	28	-6	36
Epl-Europhys Lett	22	28	-6	36
Journal of Materials Research	23	23	0	0
Physica Scripta	24	30	-6	36
Journal of Korean Physical Society	25	24	1	1
Continued….				
			Σd^2	10781

n value in 104. The r value was found as 0.94. The relationship with the parameters are very strong. In other words, the two ranks are going almost parallel to each other.

12. SUGGESTIONS AND RECOMMENDATIONS

Libraries associated with research institutes are always facing two issues with regard to journal subscription viz. yearly cost increase and the budget constraints. These two issues are very affecting the proper collection development in libraries as the libraries are bound to restrict the journal subscription and cannot cater to the exact need of the library users. Collection development policy will be reviewed annually and updated when appropriate, or as and when the Library management considers it necessary. As material subscriptions undergo increased scrutiny, and budgets are streamlined, libraries must improve collection development decisions with actionable, quantitative data. Defining the most valuable journals for a library or research population is critical. A judiciary way for selecting the journals to be subscribed is a big task. Libraries are advised to go for journals which are locally well used than the journals used at global level. Local Journal Utilization Report assists individuals looking to inform collection development decisions and market research initiatives.

The methodology followed in the present study has an extensive way of assessing the local usage. Google scholar, the popular scholarly database which gives citing information may be made use for the purpose in case *Scopus* or *Web of Science* are not accessible to use. Even small college or university libraries may be able to carry out usage assessment even though he databases like *Scopus* or *Web of Science* are not accessible. Google scholar, the most common scholarly database. The availability of the publications of a particular institute is sufficient to get the ranked list of preferred journals for publishing by the institute. The references in the publications of the institute may be analysed to get the ranked list of journals referred by the researchers in the institute. These two lists can be used to assess the local usage. The amount of work to be carried depend upon the size of the institute or the quantity of publications from the institute.

As a recommendation to the library science professionals, the study proposes that there can be a list of journals which are not subscribed libraries and highly used for citing/publishing may be distributed to the researchers in the concerned institutes asking them to select a certain number of journals which are highly relevant to the areas of their own research. Then according to the priorities of the journals may be ranked based on the suggestions. This methodology is ideal in a university or research organisations where research is being carried out a multi-disciplinary subjects. Even the subject-wise usage of journals may be obtained so that management can decide the journals to be subscribed based on the budget for each basic disciplines.

Recommendations based on research observations have great impact on decision makers and administrators. The following are few recommendations based on the observations:

1) The methodology described in the study may be adopted to any library with access to any one of the databases.
2) It is recommended that even smaller libraries can also take up journal usage studies without the databases for adding new journals or discontinue any journals.
3) There are some journals subscribed by BARC Library and the usage in terms of number of times referred in publications of BARC scientists & engineers

are very less. Few journals are given in main thesis which may be considered for discontinuations.

4) The above list may be considered for discontinuation of subscription. The study has considered another six set of journals viz. 1) journals referred by BARC scientists and engineers as per *Scopus* database, 2) journals referred by BARC scientists and engineers as per *Web of Science* database, 3) journals citing publications of BARC scientists and engineers as per *Scopus*, 4) journals citing publications of BARC scientists and engineers as per *Web of Science* database, 5) journals preferred by BARC scientists and engineers for publishing their articles as per *Scopus* database, and 6) journals preferred by BARC scientists and engineers for publishing their articles as per *Web of Science* database. The study suggests that the 38 core journals are occurred in all six ranked lists based on usage and not subscribed by BARC Library. The study is strongly recommending that journals which are less used and subscribed by BARC Library may be replaced with the these journals.
5) Assessing the usage of journals in different subjects is recommended in an institution where multi-disciplinary research is going on.

The denial reports or turn-away provided by publishers of the journals not subscribed are recommended to take decision on new journal suggestions.

Uniformity of usage in titles of journals is really a challenge to those who are undertaking the references as their data for research. The database producers may take this suggestion as very serious.

13. AREAS OF FURTHER RESEARCH

COUNTER (Counting Online Usage of Networked Electronic Resource), a standard designed to count the usage of library electronic resources (journals, databases, books, reference works, and multimedia databases), called the Code of Practice.

COUNTER Code of Practice enables publishers and vendors to report usage of their electronic resources to the end users. Library managers can compare data received from different publishers and vendors. COUNTER usage statistics provide librarians

or other authorised persons with statistics about their institutional/company use of online journal subscriptions. The common reports are:

TR_B1: No. of times e-books requested
TR_B2: No. of times access denied for e-books by publishers
TR_B3: No. of times Books accessed
TR_J1: No. of times journal articles (online) requested
TR_J2: No. of times access denied for journal article (online)
TR_J3: No. of times accessed journal articles (online)
TR_J4: Yearly request of journal articles (online)

Reports tagged by TR_J1 and TR_J2 is highly used by libraries to assess the intensity of usage of online journals which are being subscribed and non-subscribed. The TR_J2: denials are heavily used for taking the decision on new subscriptions. TR_J3 is used for assessing the usage of already subscribed journals. In depth analysis of usage reports combining the cost factors are another area of research.

Usage of journals may vary according to subjects. Sometimes, very few people may be working on a narrow field. In that case a flat assessment of journals may mislead to wrong interpretations. It happens in institutions where multi-disciplinary research is going on. A further research on subject-wise analysis of the usage of journals is being recommended.

14. CONCLUSION

Generally, librarians are assigned with the responsibility of selection, development and maintenance of the library resources. But in contrary, in a research environment, the participation of researchers in the process is very important as they are the ultimate stakeholders. New ways of working and a new awareness of what is possible are changing users' usage of libraries and creating the need for new organizational structures to provide flexible and responsive information and library services. Facing a rapidly changing and unpredictable environment, libraries must be positioned to constantly assess and modify their operations. Selecting materials is the most vital aspect of the work of libraries. Librarian is responsible to two things: understand the local usage and the selection. The local usage may be assessed based on a single parameter or many parameters. The present study has provided different models

which may be adopted depending upon the availability of the resources to assess the local usage.

Journals which are some way or other way related to the researchers are definitely relevant to their research works. The local usage ranking is very much required as the journals relevant to the researchers may not able to subscribe by the parent organization. Ranking by different parameters may be added and have a re-ranking for this. Any sources which give citation data may be used to extract the journals citing the publications and it won't make much difference when the highly authentic sources like *Scopus* or *Web of Science* are used.

The abridged model of the study may be adopted by college libraries and other small academic libraries where the number of journals subscribed by the libraries are very small in number. Some weightages are to be given for journals under consideration for subscription and other parameters relevant to an institution may also be considered for selection of journals. For example, some institutions may be conducting research on multi-disciplinary areas and there may be few people may working in certain areas. In that case the usage of journals relevant to that areas may be underused when compared to other core areas. These things are to be given due importance when selection of journals are concerned.

The present day data on downloads and denials (turn-aways) of the journals are very much used to assess the usage. Again the cost and other parameters are important for selection or de-selection of journals even though we have the data on local usage. The usage data vary from time to time. Usage statistics and citation analysis can be combined in a meaningful way. This study provided an approach that is a more targeted and possibly strategic examination of usage statistics by filtering those statistics through the lenses of journals that are important to academic departments. The described approach allows for evaluation of usage statistics in a meaningful way - meaningful both to faculty outside the library and those within the library. This approach encourages stakeholders to think differently about evaluating usage statistics. Cost per use means nothing without the proper context and perspective. Using this approach is labor intensive but perhaps justifiable when the amount of money academic libraries spend on electronic journal and database subscriptions is taken into consideration. In conclusion, combining measures of citations and

publications in conjunction with usage data provides a better view of the relative merits of an electronic resource package.

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